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DISCUSSION OF DESIGN CHARACTERISTICS OF LOCK SYSTEMS IN THE UNITED STATES: A SYMPOSIUM

(Published in January, 1950)

By Basil Standing, and A. Frederick Griffin

WATERWAYS DIVISION

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BASIL STANDING,[13] Assoc. M. ASCE.—When turbulence is likely to occur in the lock chamber as the result of entrained air expelled in the flow, Mr. Griffin recommends placing the culverts well below the elevation of the lower pool, so that the hydraulic gradient is above the roof of the culvert. If this were to entail considerably increased costs for extra excavation, an alternate measure might be the fitting of bleeder valves, operated manually or automatically, at selected points along the culvert.

A model to be tested at the Whitworth Research Laboratories, University of Manchester (Manchester, England), will comprise a number of culverts in a lock 800 ft long and 100 ft wide, with standpipes at several predetermined points along each culvert to permit entrained air to escape. It would be interesting if Mr. Griffin would discuss the relative potential merits of such air valves.

Another point that deserves serious consideration is the question of the settlement of any silt carried through the culverts when a lock is being filled from, say, a tidal river. Depending on the degree of turbulence produced, the silt may either be: (*a*) Deposited in its entirety at some place in the vicinity of the inlet ports, eventually building up into banks or mounds sufficiently high to form serious obstructions, at low water, to vessels in the lock, or (*b*) distributed, more or less evenly, over the entire floor area of the lock. Thus the two requirements—(1) a minimum of turbulence of the kind tending to cause motion of vessels, and so to increase live stresses, and (2) a flow, from the entry ports, of such type as to avoid the creation of uneven silt deposits or the disturbance of even silt deposits already in existence—may be conflicting, and model tests may indicate the need for a compromise between the two.

The Symposium provides a complete picture of the many considerations involved in the design of lock systems.

A. FREDERICK GRIFFIN,[14] M. ASCE.—The pertinency of the two problems presented by Mr. Standing in his discussion is fully realized. At the Alton Locks, No. 26 in the Upper Mississippi River series of locks and dams, the tops of the filling and emptying culverts are very close to extreme low water. At such times the lift at the locks is about 24 ft. The main lock is 110 ft wide and 600 ft long. The auxiliary lock is 110 ft by 360 ft. The problem of air entrainment was carefully considered during the design of the locks and, as a result, vent systems with 12-in. risers spaced some 75 ft apart were installed in each lock wall. The vents in the river wall open to the atmosphere on the river side of the wall, slightly above upper pool elevation. Those in the landward and intermediate walls are each connected to a 36-in. header parallel to and above each culvert at approximately upper pool elevation. The 36-in. pipes dis-

NOTE.—This Symposium was published in January, 1950, *Proceedings*. The numbering of footnotes in this Separate is a continuation of the consecutive numbering used in the original paper.

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charge into the bullkhead recesses at the downstream valves. The probable degree of efficiency of the vents is unknown as varying amounts of turbulence are evident in the lock. The lockmaster at Lock and Dam No. 26 advises that water and air are jetted from the vents and 36-in. headers during low tailwater and he considers that the systems are efficient because of the hissing sound that occurs at most other stages. All valves at this installation are the Tainter-gate type, sealing against the upstream side of the valve recess.

Model tests for the Pickwick Lock (110 ft by 600 ft) on the Tennessee River, made in the Hydraulic Laboratory, University of Iowa (Iowa City), demonstrated that best results were obtained with the Tainter valves facing downstream, the reverse of previous installations. The top of the culvert is 5 ft below normal lower pool in this instance and the lift is about 57 ft. The report on model tests states

> "* * * with the tainter valve faced downstream, the water surface in the valve recess drops to the top of the culvert for only a brief period, just at the completion of the opening of the valve, then rises as the pressure in the culvert increases."

These tests also demonstrated the value of sealing the valve-bulkhead recesses to prevent ingress of air at those points, thus obtaining what has been termed "a closed system." In connection with model tests for the Guntersville Lock (60 ft by 360 ft), another Tennessee River lock (the top of culvert below normal lower pool is 9 ft and the lift about 39 ft), it was found that the prototype with valves faced downstream and equipped with vents, could be operated satisfactorily with the open culvert system. With the closed culvert system, vents are unnecessary. Experience indicates that it is best to keep the ingress of air into the culvert system to an absolute minimum. It is difficult, if not impossible, to remove entrained air before it reaches discharge ports. It is evident that vent systems can be of considerable benefit where it is impracticable to place culverts below the hydraulic gradient or install a "closed system," as described.

Silting in the vicinity of filling ports in the lock chambers has not proved to be a serious problem. Silting upstream from the miter gates is of some concern. Experience has indicated that movement of miter gates to and fro near the gate recesses, together with some flushing, can be of considerable help in overcoming this problem. Silting in the lock approaches is taken care of by occasional dredging. It is thought that the use of a small dredge, clamshell excavator, or perhaps a drag, supplemented by flushing via the filling culverts, would provide a reasonable method of removing silt deposited in the lock chamber.

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DISCUSSION OF MOVEMENTS IN THE DESICCATED ALKALINE SOILS OF BURMA

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By Hans F. Winterkorn, J. E. Jennings, and
F. L. D. Wooltorton

SOIL MECHANICS DIVISION

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